§ 112, second paragraph; Claim 54 was rejected under 35 U.S.C. § 102(b) as anticipated by Zocholl (U.S. 4,914,386); Claims 28 and 29 were rejected under 35 U.S.C. § 103(a) as unpatentable over Elton et al (U.S. 4,853,565, hereinafter Elton '565) in view of Harrold et al (U.S. 4,156,846); Claims 28-30 and 34-36 were rejected under 35 U.S.C. § 103(a) as unpatentable over Breitenbach et al (U.S. 4,785,138) in view of Harrold et al; Claims 31 and 32 were rejected under 35 U.S.C. § 103(a) as unpatentable over Breitenbach et al in view of Harrold et al and further in view of Elton '565; Claim 33 was rejected under 35 U.S.C. § 103(a) as unpatentable over Elton '565 in view of Harrold et al and further in view of Elton et al (U.S. 4,622,116, hereinafter Elton '116); Claims 37 and 38 were rejected under 35 U.S.C. §103(a) as unpatentable over Elton '565 in view of Harrold et al and Shildneck (U.S. 3,014,139); Claim 39 was rejected under 35 U.S.C. § 103(a) as unpatentable over Elton '565 in view of Harrold et al, and Shildneck and further in view of Williamson et al (U.S. 3,593,123); Claim 58, supposedly Claim 55 as Claim 58 does not exist, was rejected under 35 U.S.C. § 103(a) as unpatentable over Elton '565 in view of Shildneck and Tanaka et al (EP 0 671 632); Claims 50-53 were allowed; and Claims 40-49 were indicated as containing allowable subject matter if rewritten in independent form.

Applicants acknowledge with appreciation the indication that Claims 50-53 were allowed and Claims 40-49 would be allowable if rewritten in independent form. However, since Applicants believe themselves entitled to the scope of protection stated in independent Claim 37, Claims 40-49 have presently been maintained in dependent form.

In response to the objection of the drawings, submitted herewith is a separate Letter Requesting Approval of Drawing Changes requesting approval for changing Figure 1 such that a sheathing layer 44 is shown surrounding the second semiconducting layer 15. The substitute specification has been amended to include a reference to the sheathing layer 44 in

the context of Figure 1. These changes are believed to find support in the specification as originally filed, including the claims,[1] and thus, add no new matter. Upon receiving approval for the requested drawing changes and upon receiving a formal notice of allowance, Applicants will file formal drawings including the requested drawing changes.

Further, Claims 31 and 38 have been amended such that no reference is made to a feature not shown in the drawings. No new matter has been added.

In response to the rejection of Claims 29-32 under 35 U.S.C. § 112, first paragraph, as containing subject matter which "was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filled, had possession of the claimed invention," Applicants respectfully submit that the limitation of Claim 29 is inherent for the cable of the present invention as a first semiconducting layer surrounds and is in contact with an electrical conductor and therefore, the potential of the first semiconducting layer and the electrical conductor are substantially the same.

In regard to the rejection of Claims 30-32, the outstanding Office Action states:

> the equipotential surface formed by the second semiconducting layer is not described in the specification and it is not clear where and with respect to what the surface is equipotential.[2]

It appears that the outstanding Office Action confuses the meaning of an equipotential surface, a potential, and a voltage. As described for example in Halliday, Resnick, and Walker, in Fundamentals of Physics, 5th edition, part 3, chapter 25 starting at page 601, a potential is an absolute value which cannot be measured, and therefore is meaningless to measure the potential relative to another object. A voltage is a quantity that describes a

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[1]See, e.g. original Claim 11.

[2]Outstanding Office Action, page 3, lines 6-8.

difference in potential of a point relative to another point and therefore, for a voltage, a point of reference is necessary. Further, an equipotential surface is defined as an imaginary or real surface whose points have the same potential and therefore, the equipotential surface cannot be defined relative to another object. Accordingly, the above rejection is respectfully traversed. Furthermore, Claims 30-32 find support in the substitute specification at page 5, lines 5-7.

Claims 29-32 were also rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to make and/or use the invention.[3] In view of the above argument regarding an equipotential surface, Applicants respectfully traverse this rejection as Claims 29-32 are enabling to one of ordinary skill in the cable art.

In response to the rejection of Claims 28-36 under 35 U.S.C. § 112, second paragraph, Claim 28 has been amended and it is believed that Claims 28-36 are definite and particularly point out and distinctly claim the subject matter. Claim 28 has been amended to recite a first semiconducting layer, a solid insulating layer and a second semiconducting layer, all of these limitations finding support in the original specification. None of these changes are believed to raise an issue of new matter. Further, Claim 34 has been amended to correct a typographical error to recite "strands" instead of "stands." Claims 28-36 are thus believed to be definite under 35 U.S.C. § 112, second paragraph, and the outstanding rejection on that basis is believed to have been overcome. If, however, the Examiner disagrees, the Examiner is invited to telephone the undersigned so that mutually agreeable claim language may be identified.

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[3]Outstanding Office Action, page 3, lines 9-12.

In response to the rejection of Claim 54 as anticipated by Zocholl, Applicants briefly recapitulate the claimed invention. Claim 54 is directed to a method used in a rotating electric machine having a rotating field circuit and configured to be directly connected to a distribution or transmission network.

Zocholl is directed to an improved thermal protection for large induction motors under critical conditions of high inertia starting, restarting, a locked motor or an overload condition.[4] Zocholl does not teach a method employed in a rotating electric machine having a rotating field circuit and configured to be directly connected to a distribution or transmission network having an electric field winding having at least one electric conductor, a first layer with semiconducting properties surrounding the conductor, a solid insulating layer surrounding the first layer, and a second layer with semiconducting properties surrounding the insulating layer, as required by Applicants' Claim 54. In view of this difference, and in light of MPEP § 2111.02, which states:

> Any terminology in the preamble that limits the structure of the claimed invention must be treated as a claim limitation,

the rejection of Claim 54 based on Zocholl is respectfully traversed.

Amended Claim 28 is directed to a rotating electric machine having a rotating field circuit configured to be directly connected to a distribution or transmission network. The rotating field circuit comprises an electric winding having an electric conductor, a first semiconducting layer surrounding and in contact with the electric conductor, a solid insulating layer surrounding and in contact with the first semiconducting layer, and a second semiconducting layer surrounding and in contact with the solid insulating layer. Further, the

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[4]Zocholl, column 4, lines 48-60.

rotating field circuit has a detecting circuit configured to detect an earth fault in the rotating field circuit.

The invention of Elton '565 is about an insulator material, namely a pyrolized glass fiber layer that may be used in a variety of applications. For example, Elton '565 describes surrounding conventional bar-type windings of an electric machine with a layer of pyrolized glass fiber in electrical contact with ground to minimize corona discharge by providing a path to ground to bleed off built up charges.[5] Elton '565 also describes using a semiconducting pyrolized glass fiber layer to equalize the potential on the exterior of the insulator of a cable.[6] Elton '565 describes yet another application of the pyrolized glass fiber layer as a way to protect electronic components by coating the exterior of a housing with the semiconducting pyrolized glass fiber material.[7]

However, Elton '565 does not teach or suggest that the cable shown in Figure 7 could be used as a winding in a rotating electric machine having a rotating field circuit, and configured to be directly connected to a distribution or transmission network. On the other hand, the cable in Elton '565 is but one of several exemplary applications of the pyrolized glass fiber layer described in Elton '565. It appears to be completely coincidental that Elton '565 uses a winding (also referred to in Elton '565 as an "armature bar") and also a cable (as well as a chassis for an electric circuit) as exemplary uses for the pyrolyzed glass insulator material. There is nothing in Elton '565 to suggest a desirability of using the cable embodiment shown in Figure 7 of Elton '565 as a substitute for a conventional bar-type

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[5]Elton et al., column 5, lines 49-63.

[6]Column 7, lines 34-37.

[7]Column 7, lines 48-column 8, line5.

winding in a rotating electric machine having a rotating field circuit, and configured to be directly connected to a distribution or transmission network.

Elton '565 recognizes that in the end-winding region just outside of the stator of an electric machine, there will be problems caused by strong electric fields. As a solution, Elton '565 describes using a known grading near the stator to allow some of the accumulated charge to bleed off to the stator, thus reducing the risk of arcing, but Elton '565 offers no other solutions to the problems in the end-winding region. The strong electric fields will be present throughout the end-winding region, not just near the stator. The grading used in Elton '565 will help to lessen the effects of the strong electric fields near the stator, but will not address the problems in the end-winding region away from the stator. Elton '565 uses rigid bar-type windings which are able to withstand mechanical stresses caused by induced fields between the windings in the end-winding region, where electromagnetic fields are not contained in the winding. The mechanical rigidity of the bar-type windings suppress the amount of vibration in the end-winding region that would otherwise be present. The fact that a grading system is used to lessen the end-winding region problems near the stator in Elton '565 is further evidence that Elton '565 does not suggest using the cable of Figure 7 as a winding of a machine or a transformer/inductor, since such a cable would not have a grading.

The "invention" in Elton '565 and therefore Elton '165, is the pyrolyzed glass fiber layer. Elton '565 describes a process of immersing the winding portions in a bath of resin and vacuum pressure impregnating (VPI) the resin in the winding.[8] The VPI process results in a cured resin having no voids or gaps between layers.[9]

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[8] See Elton, column 4, lines 23-25.

[9] See Elton, column 4, lines 27-30.

The cable shown in Figure 7 of Elton '565 includes two pyrolyzed glass fiber layers, layers 104 and 110.

> The internal grading layer 104 is a semi-conducting pyrolyzed glass fiber layer as disclosed herein. . . . An insulation 106 surrounds internal grading layer 104. On the external surface of insulation 106, a semi-conducting pyrolyzed glass fiber layer 110 equalizes the electrical potential thereon.[10]

As further evidence that the cable shown in Figure 7 Elton '565 would not be suitable as a winding in a rotating electric machine having a rotating field circuit, and configured to be directly connected to a distribution or transmission network, having two pyrolyzed glass fiber layers would cause the cable to be prohibitively stiff for winding through the slots of the electric machine. It may be possible to VPI the entire electric machine in a large resin bath after it had been wound with a flexible cable. However, such a process would not be feasible to produce both the internal grading layer 104 and the external layer 110 since an insulation layer 106 surrounds the internal grading layer 104 and both layers 110 and 104 would need to be exposed to the resin. Accordingly, while Elton '565 describes how to provide a pyrolyzed glass fiber layer for a bar-type winding, Elton '565 does not teach or suggest that the cable of Figure 7 could be used for such a purpose, especially since the cable in Elton '565 would be stiff, not flexible.

Harrold et al state in the Abstract at lines 1-3 that

> A method is provided for detecting the presence of arcing faults in the stator windings of large dynamoelectric machines, such as turbine generators.

The method in Harrold et al detects an arcing fault in the stator winding as described in the quoted paragraph, in contrast to Applicants' rotating electric machine that has a detecting circuit configured to detect an earth fault, not an arcing fault, in the rotating field

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[10] See Elton, column 7, lines 19-26.

circuit. A person skilled in the art can distinguish between an earth fault, i.e., a connection between a part of the machine and the earth, and an arcing fault, i.e., an electrical contact between two conductors belonging to the electrical winding of the machine.

Furthermore, Harrold et al does not teach what is also lacking in Elton '565, namely, a rotating machine configured to be directly connected to a distribution or transmission network, having an electric winding of a cable with the claimed structure.

Therefore, the outstanding Office Action has not established a *prima facie* case of obviousness because the combination, even if proper, fails to teach every element of the claimed invention.

Accordingly, it is respectfully submitted that the combination of Elton '565 in view of Harrold et al does not render obvious the invention defined by amended Claim 28. Because Claim 29 includes limitations similar to those already discussed in relation to Claim 28, the rejection of Claim 29 as being unpatentable over Elton '565 in view of Harrold et al is respectfully traversed for the same reasons discussed above in regard to Claim 28.

In regard to the rejection of Claims 28-30 and 34-36 under 35 U.S.C. § 103(a) as unpatentable over Breitenbach et al in view of Harrold et al, Breitenbach et al discloses in Figure 2 an electrical cable having an electrical conductor 5, a first semiconducting layer 7, an insulation layer 8, and a second semiconductor layer 9. However, Breitenbach et al does not address a rotating electrical machine for high voltage application, particularly configurations that have a large number of windings, that give rise to a number of problems that are not present in conventional rotating machines, or linear motors like that discussed in Breitenbach et al.

Further, Breitenbach et al does not address the problem of having a detecting circuit disposed in a rotating field circuit of the electrical machine and the detecting circuit configured to detect an earth fault in the rotating field circuit.

Harrold et al, as discussed above, fails to disclose a rotating electric machine configured to be directly connected to a distribution or transmission network, a detecting circuit disposed in the rotating field circuit or a detecting circuit configured to detect an earth fault in the rotating field circuit.

Even if the combination of the applied references is assumed to be proper, the combination fails to teach every element of the claimed invention. Specifically, the combination fails to teach a rotating electric machine configured to be directly connected to a distribution or transmission network, the rotating machine having an electric winding of a cable with the claimed structure, a detecting circuit disposed in a rotating field circuit or the detecting circuit configured to detect an earth fault in the rotating field circuit, as recited in Applicants' amended Claim 28. Accordingly, amended Claim 28 and dependent Claims 29-30 and 34-36 are believed to patentably distinguish over Breitenbach et al in view of Harrold et al.

Claims 31 and 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Breitenbach et al in view of Harrold et al and further in view of Elton '565. Elton '565 is asserted for its teaching of connecting the second semiconducting layer to a predetermined potential. However, as discussed above, Elton '565 does not teach a rotating machine configured to be directly connected to a distribution or transmission network and having an electric winding of a cable with the claimed structure, also lacking in Breitenbach et al and Harrold et al.

Therefore, it is respectfully submitted that a combination of the applied references, even if assumed to be proper, fails to teach a rotating machine configured to be directly connected to a distribution or transmission network and having an electric winding of a cable with the claimed structure. Therefore, Applicants respectfully submit that Claims 31 and 32 patentably distinguish over Breitenbach et al in view of Harrold et al and further in view of Elton '565.

In regard to the rejection of Claim 33 under 35 U.S.C. § 103(a) as being unpatentable over Elton '565 in view of Harrold et al and Elton '116, Elton '116 is asserted for its teaching of having two adjacent layers with substantially a same coefficient of thermal expansion. Aside from the material properties, there is nothing in Elton '116 that would cure the above-described deficiencies regarding the proposed combination of Elton '565 and Harrold et al. Consequently, it is respectfully submitted that no matter how Elton '565 is combined with Harrold et al and Elton '116, the proposed combination fails to teach or suggest the invention defined by independent Claim 28, as amended, or Claim 33, dependent therefrom.

In response to the rejection of Claims 37 and 38 under 35 U.S.C. § 103(a) as unpatentable over Elton '565 in view of Harrold et al and Shildneck, Claim 37 is directed to a rotating electric machine configured to be directly connected to a distribution or transmission network. The electric machine has a winding formed of a cable, and a detecting circuit. The cable has a current carrying conductor having a plurality of strands, an inner semiconducting layer arranged around the cable, an insulating layer arranged around the inner semiconducting layer, and an outer semiconducting layer arranged around the insulating layer. The detecting circuit detects earth faults in the rotating field circuit.

Shildneck describes a conventional low-voltage, high-current machine. As shown in Figures 1-4, the outermost layer of the winding in Shildneck (i.e., element 8 in Figures 1-4) is

made of an insulation material.[11] Furthermore, as shown in Figures 1, 3, and 4, there are openings (i.e., element 5 in Figures 1 and 4) in the stator between each of the windings.[12] Both of these features indicate that the winding and machine in Shildneck were designed for use only at low voltages. Having an insulation material as the outermost layer of the winding will lead to reliability and safety problems in the end-winding region if the machine were operated at high voltages. At high voltages, electric charge will build up on the insulation material at the end-winding region because the charge has nowhere to bleed off. This build up will accumulate until corona develops which will lead to the deterioration of the insulation material and eventual breakdown in the machine. The openings in the stator slots would also enable electric charge to build up on the insulation material of the windings near those openings. Moreover, as in the end-winding region, the charge would have nowhere to bleed off, and so, when operated at a high voltage, the accumulation of electric charge would give rise to a high voltage potential between the outer layer of the cable and the adjacent stator. Eventually, corona would develop as an ionized discharge path between the insulation material and the stator. The electric discharge from the insulation material to the stator would result in a deterioration of the insulation material, as in the end-winding region, and again, would ultimately lead to a breakdown of the machine when operated at high voltages.

Another indicator that Shildneck is designed for use only at low voltages is the arrangement of the stator slots themselves. As shown in Figure 4, the stator slots are arranged in a matrix, as opposed to radially. In order to operate a machine at the voltage levels achievable by the present invention, many turns of the windings are required. It would

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[11]See Shildneck, column 3, lines 60-63.
[12]See Shildneck, column 3, lines 50-55.

be impossible to achieve the requisite number of turns using a slot configuration such as that shown in Figure 4 of Shildneck.

Still, another indicator that Shildneck is designed for use only at low voltages is the outermost layer of the winding in Shildneck (i.e., element 8 in Figures 1-4) is made of an insulation material.[13] For higher voltages (say over 5 kV - depending of the insulator material used and insulation thickness), it is necessary to take steps to eliminate corona between an insulated conductor and a metallic member. Such corona will form in any small air pocket between the insulation material and stator slot, provided that sufficient voltage (3 kV/mm which is the condition for forming a partial discharge path in air) appears across the air space. This is, for example, discussed in US Patent No. 2,613,238, a patent cited by Shildneck (col. 1, line 60). It is known to paint a surface of insulated conductors lying in core slots of large electrical machines with semi-conducting material to establish a sheath of reasonably uniform potential at the winding within the stator slot. Despite the fact that this is known, Shildneck does not address the problem of corona discharge, which to some extent could be reduced by using thicker insulation. Instead, one object of Shildneck is to reduce the thickness required in the ground insulation (by providing a round conductor).

In machines operating at higher voltages, such as conventional machines which normally operate between 10 and 20 kV, sometimes up to 30 kV, the end portion of the winding is normally provided with an electric field control in the form of so-called corona protection varnish intended to convert a radial electric field into an axial field, which means that the insulation on the end-winding region is subject to a high potential relative to ground. The electric field control evens out the dielectric stress of the insulating material in the end-

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[13]See Shildneck, column 3, lines 60-63.

winding region, but an electric field concentration is still a severe problem in electrical machines operating at these higher voltages.

Shildneck does not have any electric field control, which is not surprising for machines that are configured to operate at lower voltages, such as the machine in Shildneck. Conventional insulation of conductors in electrical machines (such as so-called mica-tape) is produced to some extent to provide resistance to partial discharge. If the ground insulation material as used by Shildneck (silicon rubber), were subjected to partial discharge, it would eventually lead to a deterioration of the insulation material. Also, if the machine in Shildneck were operated at voltage levels of higher voltage conventional machines, the uncontrolled electric field in the end-winding region would also result in high electric field concentrations causing a high dielectric stress of the insulation material, leading to a deterioration of the insulation material, and eventual breakdown of the machine. Accordingly, it is respectfully submitted that the cable used in the machine in Shildneck and the machine itself are designed for operation only at low voltages. Moreover, there is nothing in Shildneck suggesting a desirability to modify the cable and/or machine to operate at higher voltages, or suggesting a desirability to modify the configuration of the stator of the machine.

All applied references fail to disclose or teach a rotating electric machine configured to be directly connected to a distribution or transmission network, the rotating electric machine having an electric winding of a cable with the claimed structure, a detecting circuit disposed in a rotating field circuit, and the detecting circuit configured to detect an earth fault in the rotating field circuit, as recited in Applicants' independent Claim 37. Therefore, even if the combination of the applied references is assumed to be proper, the combination fails to teach every element of the claimed invention. Accordingly, Applicants respectfully submit

that amended Claim 37, and Claim 38 dependent therefrom, patentably distinguish over Elton '565 in view of Harrold et al and Shildneck.

In response to the rejection of Claim 39 under 35 U.S.C. § 103(a) as unpatentable over Elton '565 in view of Harrold et al, Shildneck, and Williamson et al, Williamson et al is asserted for its teaching of an excitation system which supplies a voltage to a field circuit, an injection and measuring unit arranged in the excitation system for detecting a fault current in the rotating field. However, Williamson et al does not teach or suggest what is also lacking in Elton '565, Harrold et al and Shildneck, namely a rotating electric machine configured to be directly connected to a distribution or transmission network, the rotating electric machine having an electric winding of a cable with the claimed structure, and a detecting circuit disposed in a rotating field circuit configured to detect an earth fault in the rotating field circuit

Therefore, it is respectfully submitted that no matter how the applied references are combined, the combination fails to teach or suggest the invention defined by Claim 37, or Claim 39, dependent therefrom.

In response to the rejection of Claim 55 under 35 U.S.C. § 103(a) as unpatentable over Elton '565 in view of Shildneck and Tanaka et al, Claim 55 is directed to a rotating electric machine as recited in Claim 28 and further having means for supplying an injection voltage, means for measuring a resulting error current, means for forming rectified absolute values of the injection voltage and the resulting error current, and means for transmitting the rectified absolute values to a means for monitoring a resistance of the field winding to earth.

Tanaka et al. is asserted for its teaching of means for supplying an injection voltage, means for measuring a resulting error current, and means for transmitting the values to the monitoring means. However, Tanaka et al does not teach or suggest what is also lacking in

Elton '565 and Shildneck, namely, a rotating electric machine configured to be directly connected to a distribution or transmission network, the rotating electric machine having a cable as claimed, as an electric winding, and a detecting circuit disposed in a rotating field circuit configured to detect an earth fault in the rotating field circuit

Therefore, it is respectfully submitted that no matter how the applied references are combined, the combination fails to teach or suggest the invention defined by Claim 55.

Consequently, in view of the present amendment, and in light of the foregoing comments, it is respectfully submitted that the invention defined by Claim 28-55, as amended, is definite and patentably distinguishing over the asserted prior art. The present application is therefore believed to be in condition for formal allowance and an early and favorable reconsideration of this application is therefore requested.

Respectfully submitted,

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IN THE SPECIFICATION

Please add the following new paragraph to the substitute specification at page 8, line 13:

In one embodiment of the present invention the insulated conductor includes a sheathing 44 surrounding the outer semiconducting layer 15.

IN THE CLAIMS

Please amend Claims 28, 31, 34, 37 and 55 as follows:

--28. (Amended) A rotating electric machine having a rotating field circuit, and configured to be directly connected to a distribution or transmission network, the rotating field circuit comprising:

an electric winding having,

an electric conductor,

a first semiconducting layer surrounding and in contact with the electric conductor;

a solid insulating layer surrounding and in contact with the first semiconducting layer, and

a second semiconducting layer [semiconducting] surrounding and in contact with the solid insulating layer; and

a detecting circuit configured to detect an earth fault in the rotating field circuit.

31. (Amended) A machine as claimed in claim 30, wherein:

the second semiconducting layer [is connected to] has a predetermined potential.

34. (Amended) A machine as claimed in claim 28, wherein:

the conductor comprises a predetermined number of strands, at least some of said predetermined number of [stands] strands being in electrical contact with each other.

37. (Amended) A rotating electric machine having a rotating field circuit, and configured to be directly connected to a distribution or transmission network, the rotating field circuit comprising:

a winding formed of a cable, said cable having,

a current carrying conductor having a plurality of strands,

an inner semiconducting layer arranged around the current carrying conductor,

an insulating layer of solid insulating material arranged around said inner semiconducting layer, and

an outer semiconducting layer arranged around the insulating layer; and

a detecting circuit configured to detect earth faults in the rotating field circuit.--

55. (Amended) A rotating electric machine having a rotating field circuit, and configured to be directly connected to a distribution or transmission network, the rotating field circuit comprising:

an electric winding having

an electric conductor,

a first semiconducting layer surrounding the conductor,

a solid insulating layer surrounding the first semiconducting layer, and

a second semiconducting layer surrounding the solid insulating layer;

means for supplying an injection voltage by way of an impedance between a field winding of the rotating electric machine and earth;

means for measuring a resulting error current from the injection voltage as supplied by said means for supplying;

means for forming rectified absolute values of the injection voltage and the resulting error current; and

means for transmitting the rectified absolute values to a means for monitoring a resistance of the field winding to earth.--